

Improved Models and Tools for Prediction of Radiation Effects on Space Electronics in Wide Temperature Range, Phase I

Completed Technology Project (2007 - 2007)



Project Introduction

All NASA exploration systems operate in the extreme environments of space (Moon, Mars, etc.) and require reliable electronics capable of handling a wide temperature range (-180°C to +130°C) and high radiation levels. To design low-temperature radiation-hardened (rad-hard) electronics and predict circuit and system characteristics, such as error rates, modeling tools are required at multiple levels. To determine the electrical responses of transistors and circuits to radiation events, physics-based Technology Computer Aided Design (TCAD) and mixed-level tools are required. This project will provide models and tools that will improve capabilities for prediction of technology-dependent responses to radiation in wide temperature range, which will lead to better design of rad-hard electronics, better anticipation of design margins, and reduction of testing cost and time. Future NASA missions will use nanometer-scale electronic technologies which call for a shift in how radiation effects in such devices and circuits are viewed. Nano-scale electronic device responses are strongly related to the microstructure of the radiation event. This requires a more detailed physics-based modeling approach, which will provide information for engineering models used in device and integrated circuit (IC) design. Hence, the proposed innovation: detailed high-energy-physics-based simulations of radiation events (using Geant4-based software, from Vanderbilt University) efficiently integrated with advanced device/circuit response computations by CFDRC NanoTCAD three-dimensional (3D) mixed-level simulator. This will also enable a big number of statistically meaningful runs on a massively parallel supercomputing cluster. The extreme low temperature physics models combined with radiation effects simulations will be obtained by leveraging another CFDRC project for Extreme Environment Electronics, serving the NASA RHESE Program (led by NASA-MSFC).



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

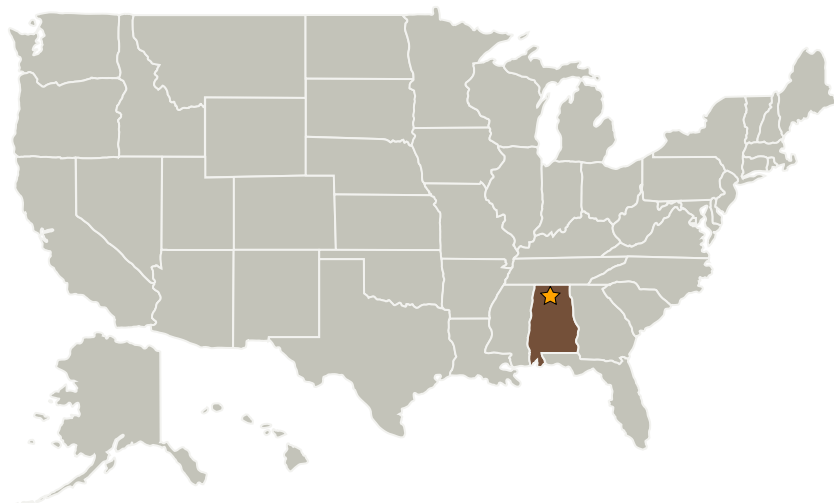
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
CFD Research Corporation	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations

Alabama

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX02 Flight Computing and Avionics
 - └ TX02.3 Avionics Tools, Models, and Analysis
 - └ TX02.3.2 Space Radiation Analysis and Modeling